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ON SPATIAL STRUCTURING OF THE F2 LAYER STUDIED BY THE SATELLITE RADIO SOUNDING OF THE IONOSPHERE DISTURBED BY HIGH-POWER HF RADIO WAVES

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We present the results of studying the characteristics of the artificial plasma structures excited in the ionospheric F_2 region modified by high-power HF radio waves. The experiments were carried out at the Sura heating facility using satellite radio sounding of the ionosphere. The plasma density profile was reconstructed with the highest possible spatial resolution for today, about 4 *km. In a direction close to the magnetic zenith of the pump wave, the following phenomena were observed: the formation of a cavity with a* 15% *lower plasma density at the altitudes of the F_2 layer and below; the formation of an area with plasma density increased by* 12% *at altitudes greater than* 400 *km. With a long-term quasiperiodic impact of the pump wave on the ionosphere, wavy large-scale electron-density perturbations (the meridional scale $\lambda_x \approx 130$ km and the vertical scale $\lambda_z \approx 440$ km) are also formed above the Sura facility. These perturbations can be due to the plasma density modulation by an artificial acoustic-gravity wave with a period of* 10.6 *m, which was formed by the heat source inside a large-scale cavity with low plasma density; there is generation of the electron density irregularities for the electrons with $\Delta N_e/N_e \approx 3\%$ in the form of layers having the sizes* 10–12 *km along and about* 24 *km across the geomagnetic field, which are found both below and above the F_2-layer maximum. The mechanisms of the formation of these plasma structures are discussed.*

1. INTRODUCTION

Ionospheric modification by high-power HF O-mode radio waves under conditions of their reflection in the F_2 region leads to the resonant excitation of plasma eigen-oscillations near the reflection height of the pump wave. Plasma waves cause a plasma heating (the electron temperature can be increased by 200–300%) and an electron acceleration by up to 5–25 eV [1–3]. The acceleration of electrons can occur in the plasma resonance region due to the transfer of energy to them from the Langmuir waves and in the upper-hybrid resonance region during damping of the upper-hybrid plasma oscillations. The first process is localized near the reflection height of a pump wave where its frequency f_0 coincides with the electron plasma frequency f_{pe} ($f_0 = f_{pe}$) and the electrons are mainly accelerated along the magnetic field [1, 4]. At the height of the upper-hybrid resonance (slightly below the reflection level of the high-power radio wave) the condition $f_0 = (f_{pe}^2 + f_{ce}^2)^{1/2} = f_{UH}$, where f_{ce} is the electron cyclotron frequency, is fulfilled. The electron acceleration by the upper-hybrid waves mainly occurs across the magnetic field lines [1, 5–7]. Accelerated electrons (with energies of 2 eV or greater) cause the plasma heating, stimulate the appearance of longitudinal currents and

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